

NASA SBIR/STTR Technologies

E1.03-8342 - Rapid Multiplex Microbial Detector



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Identification and Significance of Innovation

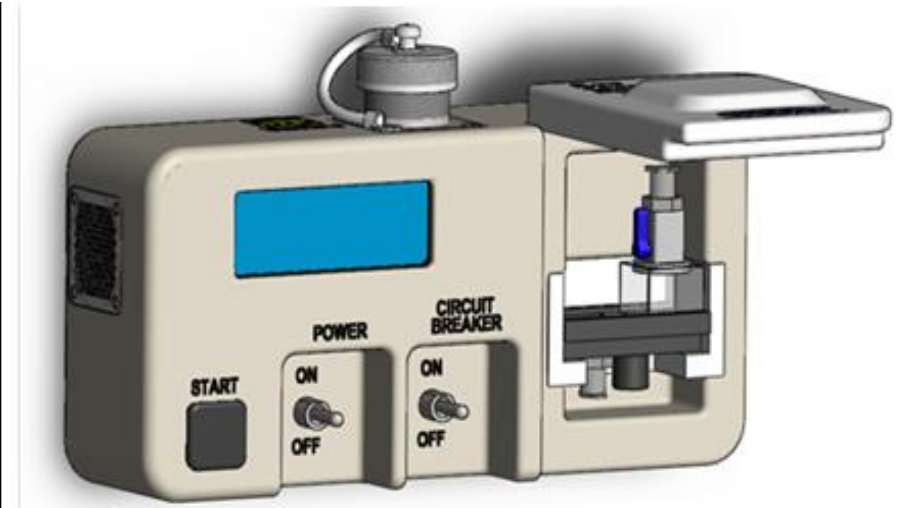
The Rapid Multiplex Microbial Detector (RMMD) is a rapid nucleic acid-based detector for spaceflight water systems to enable detection of multiple strains of microbes with minimal consumables and crew time. The RMMD amplifies the genetic sequences in a liquid sample to allow simultaneous near real-time identification of multiple waterborne pathogens. This easy-to-use device incorporates a patented polymerase enzyme that enables rapid RNA amplification by reagents with superior shelf life and thermal stability. To operate, a water sample is injected into the RMMD, where it mixes with the reagent. The RMMD heats the mixed sample and holds it at an elevated temperature for 15 minutes to amplify rRNA sequences. The RMMD then cools the sample and applies it to a simple array of oligonucleotide probes specific to the variable rRNA regions unique to the pathogens of interest. Measurable fluorescence at specific locations on the array indicates the abundance of each species in the sample.

Estimated TRL at beginning and end of contract: (Begin: 2 End: 5)

Technical Objectives and Work Plan

The primary objective of the Phase 1 activity is to develop the chemistry and hardware designs for the Rapid Multiplex Microbial Detector and demonstrate prototype hardware functionality in a laboratory setting. The knowledge gained during Phase 1 will lead to more advanced development and testing during Phase 2, including a fully functional flight-like prototype and a complete flight-ready system. We will develop the appropriate chemical structures, and hardware configurations through design, analysis, and testing. To accomplish this objective we will complete the following tasks:

- Determine which microbes will be detected during Phase 1 and Phase 2 development
- Develop lyophilization of complete isothermal amplification reactions for the microbes to be detected
- Design, develop and test a prototype Forster (or Fluorescence) Resonance Energy Transfer (FRET) detection chemistry
- Design and fabricate a benchtop prototype cartridge and processing chamber for performing rapid rRNA amplification and FRET detection
- Test performance of the benchtop prototype hardware and software



NASA Applications

The RMMD provides quantitative indication of the presence of multiple waterborne pathogenic bacteria and fungi simultaneously within 60 minutes of sampling, with minimal consumable hardware. If an infection is suspected in space, potential sources can be tested, and results determined quickly; therefore additional infections can be avoided. This technology can be used on the ISS and on future long-duration spaceflight missions.

Non-NASA Applications

The military can use RMMD for water testing in remote or resource-limited environments. RMMD can be used for surface water quality testing for research and surveillance. The RMMD approach provides the ability to quickly test potable water samples for real estate, new well, and new construction applications. RMMD technology can be used for water quality assessment for the aquaculture industry.

Firm Contacts

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NON-PROPRIETARY DATA